The relationship between quality management practices, absorptive capacity and innovation performance

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Abstract
This paper analyzes the link between Quality Management Practices (QMP), a firm's absorptive capacity and innovation performance. A proposed research model and hypotheses are tested using cross-sectional survey data from a sample of 230 leading Spanish firms. The results indicate that five QMP, leadership, information and analysis, human resource management, process management and supplier management, are directly related to a firm's absorptive capacity. Likewise, absorptive capacity is positively related to product and process innovation performance.

Keywords: Quality Management, Absorptive Capacity, Structural Model

Introduction
In the face of a business environment characterized by continuous changes and a greater turbulence and complexity, the survival of firms in the long-term is based on the development of activities related to innovation (Galanakis, 2006).

One of the key elements in developing a culture of innovation is knowledge (Jensen et al., 2007). According to Murovec and Prodan (2009), knowledge and innovation are two interrelated capacities: new knowledge arises from the processes of innovation. In turn, the application of this new knowledge leads change and innovation. Given the great importance attributed to knowledge management in the development of innovation capacity, we must study the firm's ability to absorb new knowledge, its determinants and its impact on innovation.

Cohen and Levinthal (1990) defined absorptive capacity as a firm's ability to recognize the value of new, external information, assimilate it, and exploit it to commercial ends. To have a strong knowledge base, the firm must absorb information from all kinds of sources and not limit itself to internal sources alone. Teece (1996) establishes that sustaining a competitive advantage depends on factors such as the correct use of internal and external knowledge in the generation of innovations. However, he specifies that external knowledge does not benefit all firms to the same extent. Rather, the benefits derived from external knowledge will be determined for

each firm by the firm's own resources and organizational practices. In that respect, Quality Management (QM) is one of the most prevalent and established set of Operations-related organizational practices (Sousa and Voss, 2002). Therefore, this study focused specifically in the following goals: a) analyzing of the antecedents of absorptive capacity in greater depth, b) determining the effects of the different Quality management Practices (QMP) on absorptive capacity, and c) analyzing the influence of absorptive capacity on innovation performance.

This paper is structured as follows. First, we review the literature, present our conceptual framework of absorptive capacity, its antecedents (QMP) and its influence on innovation performance, and develop hypotheses. Next, we describe the research methodology (survey) used to empirically test the proposed model. We then present the results of the empirical analysis. Finally, we discuss the implications of the results and conclusions.

Literature review and hypotheses

Absorptive capacity: concept and antecedents

Absorptive capacity is defined as a firm's ability to recognize the value of new, external information, assimilate it, and exploit it to commercial ends (Cohen and Levinthal, 1990). Zahra and George (2002) propose a new stage in this outline concerning transformation: the firm's capacity to develop and redefine routines that facilitate combining existing knowledge with the acquired and assimilated knowledge.

The literature review has shown that the fields for application of the concept "absorptive capacity", as well as its level of analysis, are highly varied, with the result that there is a wide variety of elements that influence absorptive capacity. The description of the main antecedents of absorptive capacity and its justification in the literature appear in Table 1.

Table 1 – Antecedents of Absorptive Capacity

Antecedents	Definitions	Citations
Relevant prior knowledge *Common language*	A language that can be understood by all business units improve a firm's absorptive capacity through knowledge transfer.	Cohen and Levinthal (1990); Van den Bosch et al. (1999); Gupta and Govindarajan (2000); Matusik and Heeley (2001).
Knowledge complementarity	The diversity of exposure and the degree of overlap between the knowledge bases of the external source and the firm.	Lane and Lubatkin (1998); Kim (1998); Matusik and Heeley (2001); Meeus et al. (2001); Zahra and George (2002)
Experience	Firms search for new information in fields where they had past successes. Therefore, experience influences the search and the development of path-dependent capabilities of absorption new knowledge.	Cohen and Levinthal (1990); Szulanski (1996); Lane and Lubatkin (1998); Simonin (1999); Gupta and Govindarajan (2000); Zahra and George (2002)
R&D activities	R&D expenditure/total sales, level of R&D investment and the existence of a R&D lab.	Cohen and Levinthal (1990); Veugelers (1997); Stock et al. (2001)
Organizational structure (level of centralization, organizational flexibility…)	The success and efficiency of knowledge assimilated depend on whether the organization has a divisional or functional organizational structure.	Cohen and Levinthal (1990); Lane and Lubatkin (1998); Van den Bosch et al. (1999); Gupta and Govindarajan (2000); Lane et al. (2001); Meeus et al. (2001): Lane et al. (2006)
Human Resource Management	Job rotation or participation in decision making can facilitate the transfer of	Kim (1998); Lane and Lubatkin (1998); Lane et al. (2001); Daghfous

	knowledge. Human resource management can also help to stimulate the absorption of new knowledge through reward systems or/and training.	(2004); Mahnke et al. (2005); Lane et al. (2006)
Social integration mechanisms	Social networks and social integration initiatives (job rotation, participation in decision making, cross-functional interfaces, and teamwork) influence knowledge-seeking behaviors.	Gupta and Govindarajan (2000); Meeus et al. (2001); Zahra and George (2002); Jansen et al. (2005); Todorova and Durisin (2007)
Another antecedents	**Activation triggers** (events that encourage a firm to respond to specific stimuli. These can intensify a firm's efforts to learn new skills and to develop new knowledge than increase absorptive capacity, e.g., Kim, 1998; Zahra and George, 2002); **Trust** (Lane et al., 2001); **Top Management Support** (Lenox and King, 2004); **Intensity of efforts to learn** (Kim, 1998; Zahra and George, 2002); **Regimes of appropriability** (Cohen and Levinthal, 1990; Zahra and George, 2002).	

Quality Management Practices as antecedents of absorptive capacity

QM has been defined as an approach to management made up of a set of mutually reinforcing principles, each of which is supported by a set of practices and techniques (Dean and Bowen, 1994). Sousa and Voss (2002) determine that, at the empirical level, QM implementation should be based on analysis of the firm's practices, since "principles are too general for empirical research and techniques are too detailed to obtain reliable results".

QMP have been investigated extensively and reviews of these studies are developed by Nair (2006) and by Sousa and Voss (2002). One extensive literature review shows the use of seven QMP: leadership, strategic planning, customer focus, human resource management, supplier management, information and analysis, and process management (Table 2 shows a definition of each of these); practices that are also consistent with those proposed by the Malcolm Baldridge National Quality Award (MBNQA) (Curkovic et al., 2000). We argue that QMP affect absorptive capacity as these practices are intimately related to the antecedents proposed in the literature review.

First, leadership must facilitate the creation of work environments that encourage the involvement and participation of all members of the organization in the process of change and organizational learning (Wilson and Collier, 2000). According to Senge (1999), leadership is vital to construct shared vision in a learning organization, since it should promote the necessity of learning. On the other hand, Lenox and King (2004) propose top management support as an antecedent of absorptive capacity: managers establish links and relationships with other firms and within their own business units, so the information they provide will be associated with better adoption of new knowledge.

Strategic planning refers to the development and implementation of strategies and plans that focus on quality and on the analysis of performance data oriented to directing organizational improvements (Samson and Terziovski, 1999). This practice will improve the firm's existing knowledge base, and thus prior related knowledge, achieving greater diversity of information and facilitating the superimposition of external information sources, key antecedents of absorptive capacity (Cohen and Levinthal, 1990, Zahra and George, 2002).

Customer focus involves having direct and continuous contact with customers, gathering information on their tastes and needs, and using the information acquired to improve the products and services offered (Dean and Bowen, 1994). It will therefore be a source of information, improve the complementarity of the firm's knowledge base (Hansen, 2002), and provide experience (Nonaka and Takeuchi, 1995). According to

Hill and Rothaermel (2003), the relationships of the firm with its customers represent a type of power relationship that influences the absorption of knowledge.

The practice of information and analysis refers to the reach, management and use of information and other data concerning the firm to maintain customer focus, lead the organization toward excellence in quality, and improve performance (Samson and Terziovski, 1999). Because this practice will be a source of knowledge and enable the identification of possible points for improvement, it is related to the determinant of absorptive capacity "management of prior knowledge" (Zahra and George, 2002). Moreover, experience influences the search and the development of path-dependent capabilities of absorption new knowledge, and experience is also the result of benchmarking, a technique in which this practice is materialized (Garvin, 1993).

The implementation of human resource management practices allows the tacit component of knowledge to be managed indirectly (Sparkes and Miyake, 2000). The smaller this component is, the easier its acquisition and assimilation will be (Zahra and George, 2002). Besides, human resource management includes (among other techniques) job rotation, teamwork and training, which are determinants of absorptive capacity (Meeus et al., 2001). For example, teamwork favours the assimilation of the different components of knowledge and their integration into the existing knowledge base (Jansen et al., 2005) and employee participation in decision making can facilitate the flow of knowledge (Daghfous, 2004).

The management of processes and their statistical control generate and store information on the functioning of organizational processes so that they can then be improved (Rungtusanathan et al., 1997). This practice will enable the creation of a knowledge base that builds on prior knowledge, as well as subsequent complementing of the new knowledge acquired.

Finally, QM advocates that relations with suppliers be characterized by a high level of trust, fluid communication, high levels of shared information, and long-term development of the relationship (Langfield-Smith and Greenwood, 1998). These characteristics should encourage the development of common or related knowledge and its superimposition on the firm's knowledge base (Hansen, 2002). Absorptive capacity is determined by the degree of overlap between external knowledge and the firm's knowledge base (Lane and Lubatkin, 1998).

Based on these theoretical arguments, the following hypothesis is postulated, divided into a subset of seven sub-hypotheses for each QMP. Thus, the sub-hypotheses H1a, H1b, H1c, H1d, H1e, H1f and H1g refer to leadership, strategic planning, customer focus, information and analysis, human resource management, process management and supplier management respectively.

H1 (H1a…H1f): Quality Management Practices are positively related to absorptive capacity.

Absorptive capacity and innovation performance

The relation between absorptive capacity and innovation capacity has been treated extensively in the literature (Mancusi, 2004; Vinding, 2006; Murovec and Prodan, 2009). Although the existence of multiple dimensions of absorptive capacity concept, as well as the wide variety of antecedents, has given rise to very diverse results, many of these results agree in positioning absorptive capacity as a moderating variable of the results of many organizational variables.

Cohen and Levinthal (1990) relate absorptive capacity positively to innovation capacity and its performance. Zahra and George (2002) point out that absorptive capacity is a necessary condition for achieving a competitive advantage in innovation.

Lane et al. (2006) determine that innovation is a result of organizational learning and that absorptive capacity will help in the speed, frequency and magnitude of innovation. Further, both variables feed back into each other, since innovation will produce new knowledge, which will come to form part of the firm's absorptive capacity.

Among the most recent studies, we would point out the work of Fosfuri and Tribo (2008), who analyze how the firm's ability to recognize external knowledge and adapt this knowledge to its routines is reflected in the innovation process. The work of Murovec and Prodan (2009) is also significant, as it determines that, for product and process innovation to succeed, it is crucial for the firm to seek and use information from all available sources, even those based on scientific information (e.g., universities). It is thus possible to propose the following research hypotheses:

H2: Absorptive capacity will have a positive impact in…

H2a: product innovation.

H2b: process innovation.

Methodology

Wherever possible, measurement items were adapted from previous scales. Table 2 provides a summary of the measurement items used in this study and their sources.

Table 2 – Measurement sources for research constructs

Constructs	Summary of measurement items	Sources
Leadership	Creation of unity of purpose, encouragement of change, management of the environment, and use of operator's ideas in improving the business.	Adapted from Samson and Terziovski (1999)
Strategic planning	Have a mission statement which has been communicated, have a comprehensive and structured planning process, plans focus on achievement of 'Best Practice', incorporate customer/suppliers requirements, manufacturing operations are effectively aligned with the central business mission	Adapted from Samson and Terziovski (1999)
Customer focus	Use and aware of customer satisfaction surveys, use of customer complaints, actively seek of ways to improve the main product, customer focused for the last years	Adapted from Ahire et al. (1996)
Information and analysis	Benchmarking, the company's strategy in measuring performance, the availability of data and information about performance, the use of information in decision-making processes	Adapted from Prajogo and Sohal (2003)
Human resource management	Use of the concept of "internal customer", have an organization-wide training and development process, effective communication process, employee satisfaction is measured, have safety practices, multi-skilling is actively used, focus on quality importance	Adapted from Samson and Terziovski (1999)
Process Management	Degree of automation of the process, stability of production/work schedule, process design is fool-proof, employees are authorized to solve quality problems, use of statistical techniques.	Adapted from Kaynak and Hartley (2005)
Supplier Management	Long-term relationships with suppliers, they are involved in our new product development process, quality as criterion in selecting suppliers, small number of suppliers, they are qualified for quality	Adapted from Flynn et al. (1995)
Absorptive Capacity	The managerial and technical competence to absorb new knowledge, exploit new information, common style of communication, necessary skills to complete tasks	Adapted from Szulanski (1996) and Matusik and Heeley (2005)
Product innovation	Level of novelty of new products, use of latest technological innovations, speed of new product development, number of new product introduced to the market, early market entrants	Adapted from Prajogo and Sohal (2006)
Process Innovation	Technological competitiveness, novelty of technology used in process, speed of adoption of the latest innovations in processes, the rate of change in processes, techniques and technology	Adapted from Prajogo and Sohal (2006)

The sample of firms was randomly selected from the SABI database, which includes the 50,000 largest manufacturing and service companies operating in Spain. The final sample contained 2133 firms, a number that corresponds to the firms that provided full,

current, real contact information (telephone number and contact information for the informants whose profiles were appropriate for our study). Contact with the informant from each firm was established by phone, as was the response to the questionnaire. 230 responses were collected, giving a response rate of 10.78%. In all of the cases considered valid, the informants were the CEO, the quality manager or other top-level executives familiar with QM. To ensure that the respondent was a "reliable informant", we first asked about his or her training in QM, level of studies, and time in the current position.

We analyzed a sample larger than the minimum of 200 recommended for performing statistical analyses (Hair et al., 2004). We analyzed the possible non-response bias among those who answered the questionnaire by phone and those who stated reasons for either not answering it or for filling it out at another time, and verified that there were no significant differences in their demographic characteristics or in their responses for the main constructs.

After analyzing the unidimensionality and the internal consistency of the scales, we performed a confirmatory factor analysis using the EQS software package. The validity and reliability of the scales are included in Table 3. As Table 3 shows, in all cases the scales are within the accepted limits, indicating that the measurement model is good.

Table 3 – Factor loading, and reliability analysis

Construct	Number of items	Items reliability	Cronbach's alpha	AVE	Composite reliability
Leadership	6	0.760-0,890	0.925	0.690	0.930
Strategic Planning	4	0.721-0.937	0.937	0.710	0.907
Customer Focus	3	0.877-0.924	0.931	0.860	0.95
Information and Analysis	4	0.747-0.936	0.923	0.760	0.93
Human Resource Management	5	0.715-0.849	0.873	0.58	0.87
Process Management	3	0.728-0.992	0.828	0.630	0.847
Supplier Management	5	0.703-0.821	0.883	0.604	0.88
Absorptive Capacity	5	0.702-0.849	0.947	0.750	0.930
Product Innovation	5	0.744-0.808	0.911	0.799	0.952
Process Innovation	4	0.735-0.841	0.909	0.722	0.912

Results

The results of the structural analysis are shown in Fig. 1. For greater clarity, the figure includes only the values of the structural equations, not the measurement model. Firstly, the model's goodness-of-fit must be studied. According to the indicators and recommendations proposed by Hair et al. (2004), the model's goodness of fit is sufficient (NNFI=0.90; CFI=0.916; IFI=0.917; RMSEA=0.056; χ^2/d.f. = 1.8662).

Second, the results of the analysis are consistent with the hypotheses proposed above. Only in the cases of the relation between strategic planning and absorptive capacity (H1b) and the relation between customer focus and absorptive capacity (H1c) are the hypotheses not confirmed. All of the other relationships are significant. Thus, the results confirm the general lines of argument in this study: the implementation of a QM program in the firm has significant implications for absorptive capacity.

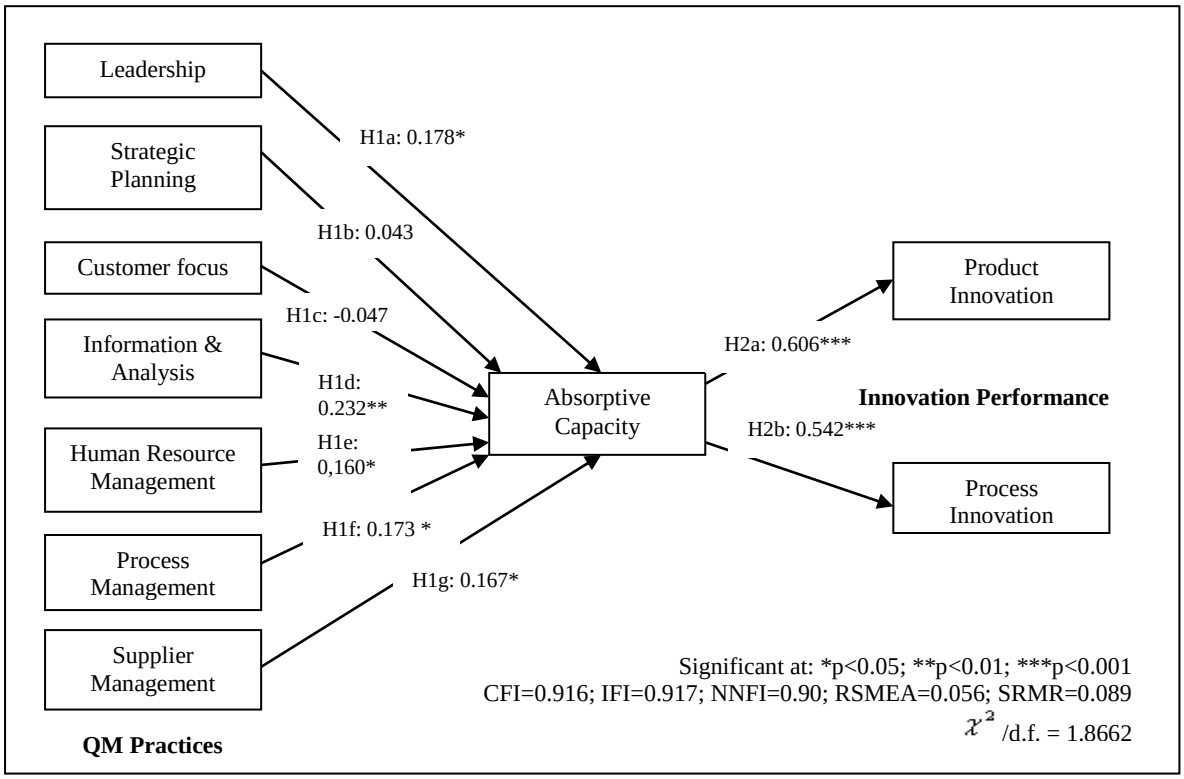

Figure 1 - Structural equation estimation

Discussion

Collectively, the results suggest that implementing a set of QMP will have a direct effect on the firm's absorptive capacity and an indirect effect on innovation performance.

Concerning QMP, leadership has a positive effect on absorptive capacity (H1a), given that enable active leadership reduces the costs of searching for new external information, as well as increasing the speed with which new information is adopted and exploited. This result is in line with previous research (Senge, 1999; Lenox and King, 2004).

The practice of "information and analysis" improves the management and use of information in the firm, affecting absorptive capacity positively (H1d). It will thus contribute to the constitution of a related prior knowledge base, a key antecedent of absorptive capacity (Cohen and Levinthal, 1990).

The practice of human resources management facilitates the acquisition and assimilation of information (H1e, Meeus et al., 2001; Jansen et al., 2005). The practice of process management (H1f) enables the generation and management of a large quantity of information, facilitating the complementarity of the new knowledge acquired with that existing in the firm, another key aspect of absorption capacity (Zahra and George, 2002). Further, the positive relationship between supplier management and absorptive capacity (H1g) shows that this practice enables high levels of fluid communication, shared information, trust, and complementarity of knowledge bases. Suppliers constitute a source of information, fulfilling the characteristics of antecedents consistent with those proposed in the literature (Lane and Lubatkin, 1998).

Finally, the results show that there is no significant relationship between customer focus and absorptive capacity (H1c). In this respect, Hill and Rothaermel (2003) conclude that obligations to current customers and other stakeholders can hinder the proper evaluation and exploitation of new knowledge. We also find that the lack of

significance of strategic planning in absorptive capacity (H1b) is an unexpected result. Deeper study of this relation to take into account strategic planning and its relation to absorptive capacity suggests a line of research that would improve understanding of this relationship.

Outside the relationships between QMP and absorptive capacity, we have established hypotheses H2a and H2b. These hypotheses show the positive relationship between absorptive capacity and innovation performance. These results are in a line of previous research (Lane et al., 2006; Fosfuri and Tribo, 2008), that absorptive capacity influences positively the speed, frequency and magnitude of product and process innovation.

Conclusions

From the analysis of a sample of 230 Spanish manufacturing and service firms, the results indicate that a set of QMP has a great impact on the firm's ability to identify, assimilate, and exploit the new information. Likewise, a firm's absorptive capacity is shown to be a key determinant of improvement in performance of innovation.

Our results have important implications for research and practice. Concerning research, this appears to be one of the first papers to simultaneously explore relationships between QMP, absorptive capacity and innovation performance. Our study provides insights on specifics antecedents of absorptive capacity, a topic that has received little attention to date (Jansen et al., 2005). Van den Bosch et al. (1999) and Todorova and Durisin (2007) noted that future research may incorporate additional antecedents of absorptive capacity. This research has also provided insights on the controversial relationship between QM and innovation (Prajogo and Sohal, 2001). Some authors assert the existence of a positive relation between quality and innovation (Naveh and Erez, 2004), while others show that this relationship is negative (Williams et al., 2006). Still others find no empirical evidence to justify this relationship (Prajogo and Sohal, 2006). Our study analyzes empirically the indirect effect of QMP on the innovation performance through the mediating effect of absorptive capacity.

For managers, this study reinforces the relevance of these three major disciplines (quality, knowledge management and innovation management) in Management. Managers must be conscious that adaptation to environment depends on the correct development of a set of organizational practices that enables them to reorganize their resources and strategies in the face of new competitive scenarios. The implementation of QM oriented to obtaining dynamic capabilities constitutes an excellent framework for competing in current markets. In sum, managers may improve and sustain an innovative-supportive culture by implementing and developing QMP that will act as antecedents of the firm's absorptive capacity. First, our results suggest that the deployment of QMP will increase firms' ability to acquire, use and exploit new external knowledge. Second, absorptive capacity is an important intermediate organizational capability through which the benefits of implementing a QM program are converted into innovation performance.

Our study does have some limitations, which in themselves provide opportunities for future research. First, the study is cross-sectional in nature, and its results can only be generalized to Spanish firms. Second, this study explores absorptive capacity using a one-dimensional construct. Possible extensions of this paper could test the proposed relationships using a multidimensional construct of absorptive capacity. Third, the empirical analysis shows that there is no significant relationship between the two QMP, strategic planning and customer focus, and absorptive capacity. Further studies might examine these relationships in greater detail. Finally, this study does not address the effects of the contextual environmental conditions of the absorptive capacity -

innovation performance relationship. The contextual environmental factors determine the effectiveness of these activities in providing the firm with a competitive advantage.

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